Environmental Assessment Missile Impacts, Illeginni Island, at the Kwajalein Missile Range, Kwajalein Atoll

ENVIRONMENTAL ASSESSMENT

MISSILE IMPACTS, ILLEGINNI ISLAND AT THE KWAJALEIN MISSILE RANGE, KWAJALEIN ATOLL TRUST TERRITORY OF THE PACIFIC ISLANDS

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For:

BALLISTIC MISSILE DEFENSE SYSTEM COMMAND
HUNTSVILLE, ALABAMA

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Abstract: This document is an environmental assessment prepared by Environmental Consultants, Inc., on behalf of the U.S. Army Engineer Division, Pacific Ocean, Corps of Engineers, for the U.S. Army Ballistics Missile Defense Systems Command (BMDSCOM), Kwajalein Missile Range Directorate (KMRD), Huntsville, Alabama. The assessment addresses the probable environmental effects of missile impacts on illeginni Islands District, Trust Territory of the Pacific Islands. This assessment has been co-ordinated through BMDSCOM and the U.S. Air Force.

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PREFACE

This document is an environmental assessment prepared by Environmental Consultants, Inc., on behalf of the U.S. Army Engineer Division, Pacific Ocean, Corps of Engineers, for the U.S. Army Ballistics Missile Defense Systems Command (BMDSCOM), Kwajalein Missile Range Directorate (KMRD), Huntsville, Alabama. The assessment addresses the probable environmental effects of missile impacts on Illeginni Island, Kwajalein Missile Range (KMR), Kwajalein Atoll, Marshall Islands District, Trust Territory of the Pacific Islands. This assessment has been co-ordinated through BMDSCOM and the U.S. Air Force.

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PURPOSE OF ACTION

The purpose of the proposed action is to measure the performance of the Mark 12 arming and fusing system utilizing a MOD 5T1 or 5T2 instrumented re-entry vehicle (RV). Strategic Air Command (SAC) of the U.S. Air Force wishes to target RV's to impact in a land environment with trees and buildings because a land impact will provide a realistic test of the arming and fusing system. The total number of RV impacts is undetermined at this time. However, this will be an ongoing test program and, initially, a minimum of three RV's will be targeted for impacts.

DESCRIPTION OF ACTION

The uninhabited island of Illeginni located in the Kwajalein Missile Range (KMR) has been selected as a potential target because this island: (1) meets the physical requirements; (2) is within Minuteman III footprint capability; (3) would provide easy access to required range support facilities; and (4) provides the system technology radar program with signal strength and look angle necessary for monitoring the test program.

The MOD 5T RV is 6.0' long and 1.8' in dianeter; weight of the RV is classified. The MOD 5T re-entry vehicle is instrumented with accelerometers, rate gyros, breakwires, temperature, pressure, and vibration transducers to obtain re-entry vehicle aerothermodynamics and structural performance data. The MOD 5T RV is designed for arming and fusing reliability assessment after exposure to a normal alert environment. Internal data are transmitted via telemetry link. Additionally, the vehicle has a beacon transponder to provide sufficient radar return for uprange, midcourse, and terminal area metric tracking.

The MOD 5T RV does not contain any explosives and there will be no detonated explosion. However, the RV may break up due to its velocity upon impact with the ground. The size of the crater caused by the force of impact has not been calculated, although could be estimated if soil densities at the impact site were provided to SAMTEC/ROPB. Some of the RV's will be aimed at terrestrial targets on Illeginni and others will be aimed at the adjacent seaward reef flat (shallow water). The probability of land/reef flat impact by the MOD 5T RV on Illeginni Island is: 70% for 4 flights; 80% for 5 flights; 90% for 7 flights; 95% for 9 flights; and 99% for 13 flights. The total number of RV's targeted will depend, in part, on the success of the initial tests.

LOCATION AND SETTING OF ACTIVITY

Illeginni Island is located within the Mid-Atoll Corridor of Kwajalein Missile Range (KMR), Kwajalein Atoll (Fig. 1). The Mid-Atoll Corridor is a range area for missile targeting in Kwajalein lagoon. Islands within the corridor are maintained without inhabitants to provide maximum range safety. In 1969, Illeginni was selected as the site of a remote SPARTAN and SPRINT (missile) Launch Facility. During November 1969, meetings between landowners and government representatives were held detailing proposed facility developments on Illeginni Island. On 23 January 1970 a lease between the United States and Trust Territories was effected for Illeginni Island. The lease expires 14 November 1994. The lease provides that the United States shall have the right to construct facilities on Illeginni Island. The lease states further that

> ... [the] United States may cut and remove trees and vegetation and may otherwise alter Illeginni Island, excluding dredging, as it may see fit without compensation to Trust Territory or the legal owners of Illeginni Island; Provided, however, that United States shall be descriminate in any cutting or alteration.
>
> The use to which Illeginni Island is put by United States shall be consistent with the provisions and purposes of the Trusteeship Agreement relating to the administration of the Trust Territory of the Pacific Islands.

> United States shall have quiet and continuous possession and enjoyment of said Illeginni Island during the existence of this Agreement.

Construction on the island commenced in April 1970. In addition to about 25 buildings (some temporary) and structures, a boat harbor and 30-foot high, flat-topped mound (launch pad) were built on the island. The first SPRINT mission was launched from Illeginni in March 1972. The base reverted to inactive status at the end of 1973, although a remote (unmanned) communications relay station is presently located there. Additional details on this period in the history of Illeginni may be found in an Environmental Assessment for construction activities on Illeginni produced by the U.S. Army Corps of Engineers, Pacific Ocean Division (1973). It may be pointed out that proposed plans to construct an airport runway on 35 acres of landfill at Illeginni (described in the above cited EA) were not realized.

The marine and terrestrial environments of Illeginni were studied in late 1972 (Losey, 1973). In October 1977, biologists from Environmental Consultants, Inc. (ECI) spent 48 hours on Illeginni, extending earlier terrestrial and marine surveys for the purpose of contributing to the present Environmental Assessment (see ECI, 1977).

ENVIRONMENTAL SETTING

Physiography

Illeginni Island is, technically, an islet or *motu*: an emergent deposit of sand, rubble, and boulders on a coral-algal reef platform. Illeginni is located on a leeward (southwestern) reef adjacent to West Onemak Pass (Fig. 2), a deep channel connecting Kwajalein Lagoon with the open ocean. Aerial photographs of Illeginni and the surrounding reef were utilized during an October 1977 ecological reconnaissance (ECI, 1977) to produce the maps shown here in Figures 3, 4, and 5. These maps plot the distribution of substratum (bottom) types and

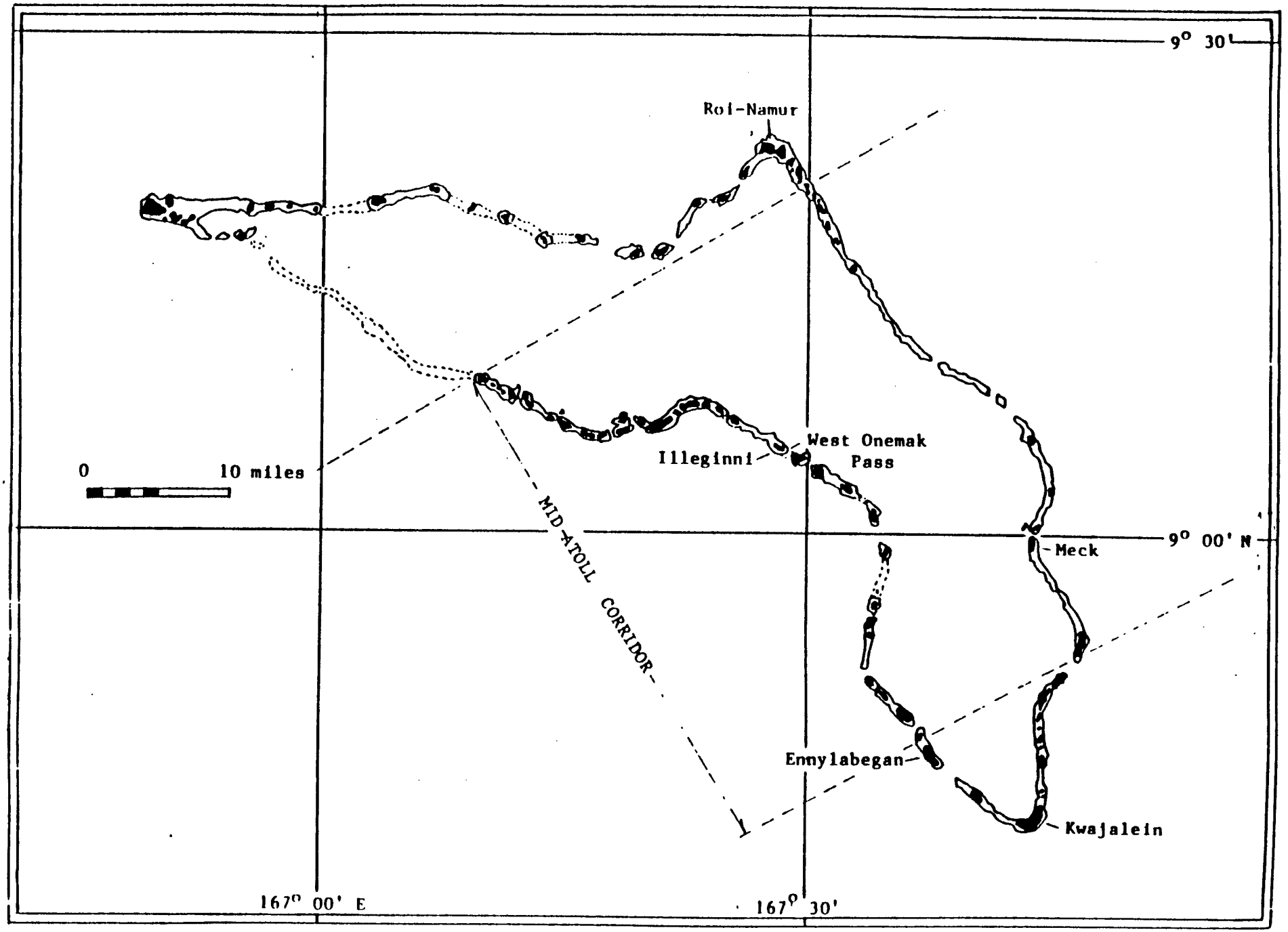


Figure 1: Kwajalein Atoll.

general physiographic zones, and relate to the distribution of biological assemblages on the reef flat.

Illeginni is approximately 33 acres in extent. Maximum length along an axis parallel with the trend of the platform reef on which the island sits, is over 2800 feet. Maximum width is about 1200 feet at the end adjacent to West Onemak Pass. Most of the island, however is closer to 400 feet in width and narrows to 300 feet near the middle. The island is composed of sand mixed with carbonate fragments (soil type: a Shioya loam poor in organic material). The island presents a level aspect approximately five feet above mean sea level.

The shoreline (beach) around Illeginni represents depositional accretions in consonance with short-term (waves) and long-term or infrequent (storms) physical forces impinging on the island. Around most of the island the beaches are composed of coarse carbonate fragments (RB = rubble, shingle, or cobble, and boulders). Beaches composed entirely or predominantly of sand (SB) occur in a few sheltered areas or, more frequently, above a lower shoreline of shingle or indurated limestone. Highly eroded limestone (i.e., beach rock or erosion remnants of elevated reef rock; LB) occurs along both the lagoon and ocean shore of the central part of the island, and appears as scattered remnants along the lagoonward shore at the west end of the island.

Characteristic of reef islets on leeward reefs, Illeginni is situated nearer the seaward margin of the reef than the lagoonward margin. Thus, the seaward reef flat, which is between 150 and 300 feet wide, is considerably narrower than the lagoonward reef flat, which exceeds 600 feet in width.

Northwest of Illeginni, the platform reef extends for approximately 6 miles to Ujajiirukku Pass and the island of Wojeirok. Width of the interislet reef is approximately 1200 feet, although it is somewhat variable because of an irregular (scalloped) lagoon margin. The interislet reef flat (Fig. 3) is

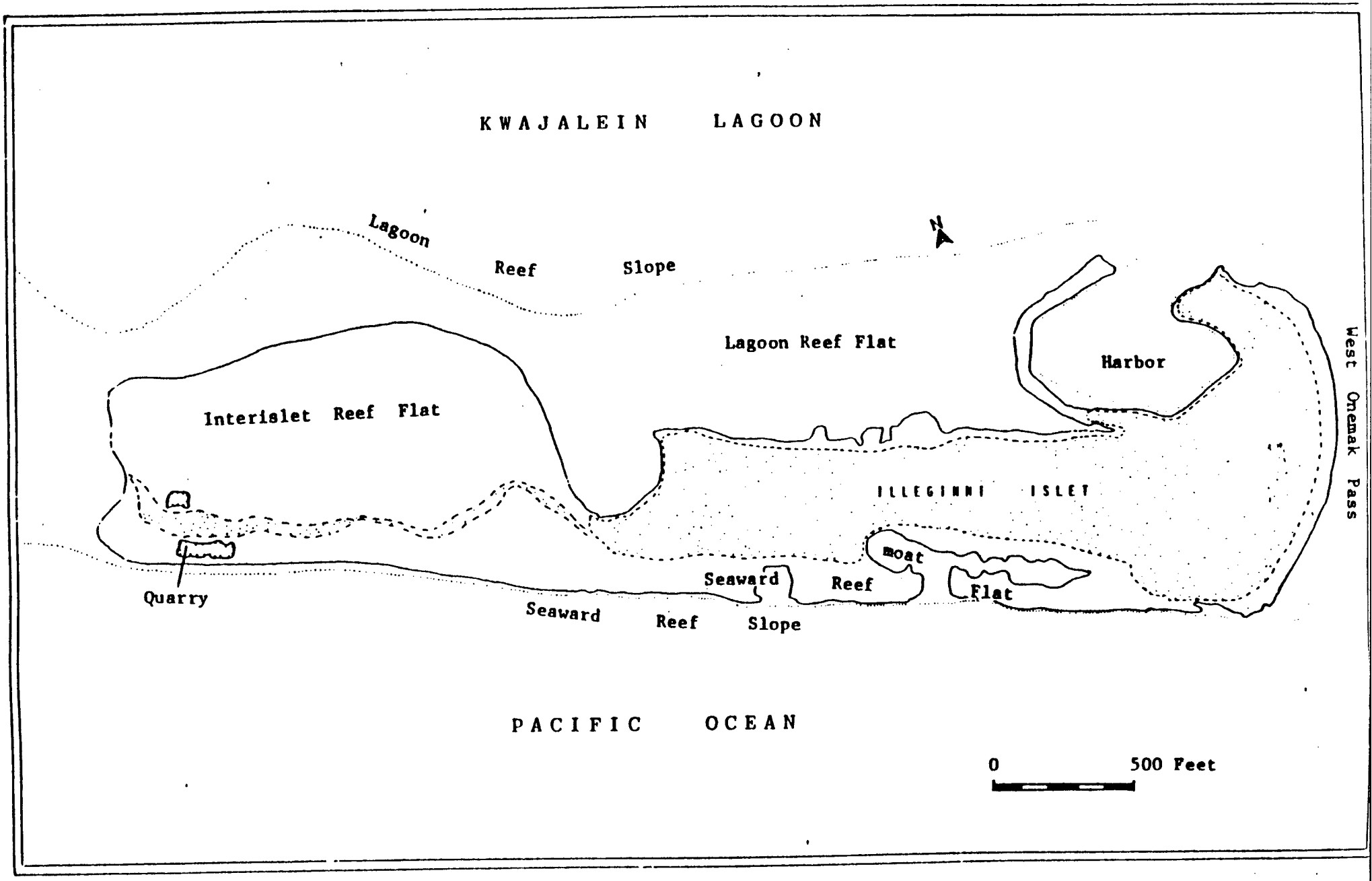


Figure 2: Illeginni Island.

shallow: much of the surface is exposed during low tides. In addition, about 100 feet back from the seaward margin is a discontinuous band of sand and rubble formed into a narrow bar partially emergent at high tide. A portion of this bar has been artificially elevated by material added during past quarry operations on the reef flat 1800 feet northwest of Illeginni.

Much of the reef flat seaward of Illeginni is exposed at low tide, as is the narrow reef flat along West Onemak Pass. The lagoon reef flat, on the other hand, is covered to a depth of between 1 and 3 feet at low tide. Mean tidal range at Kwajalein is 3.5 feet, and the diurnal range (difference between mean of higher high water and mean lower low water) is 5.0 feet (U.S. Dept. of Commerce, 1976). During higher high water of a spring tide, depth of water over the interislet and seaward reef flats would exceed five feet.

The seaward margin of the reef flat (LM) projects as fingers several yards long, a yard or so wide and spaced about a yard apart. The limestone surface here is rough and irregular and awash at lower low water. The seaward slope of the reef appears, in aerial photographs, to extend as a sloping terrace for considerable distance offshore (water depth 600 feet seaward of the reef margin is estimated at approximately 40 feet). This terrace is marked by fingers of reef rock with intervening sand channels (spurs and grooves).

The reef platform slopes gently or is nearly horizontal across the interislet reef in the lagoonward direction. At lower low water only a few inches of water may cover the surface while low mounds and sheets of depositional material may project a few inches above the water surface. Near the lagoon margin the limestone dips to an undulating surface between three and six feet deep, then rises to nearly the low water level before terminating in a steep talus slope (lagoon reef slope) descending to a 60 foot depth of the lagoon bottom.

Figures 3, 4, and 5: These figures represent interpretations from ground reconnaissance of aerial photographs of Illeginni and the surrounding reef. The marine realm has been subdivided into two zones: (1) a beach zone (indicated by LB, RB, SB), and (2) a reef zone (indicated by LR, SR, BR, S/BR). The beach zone is defined here as that portion of the land extending from the normal upper limit of wave swash (non-storm conditions) to the base of the beach where there is a distinct change (decrease) in slope of the substratum. The reef flat extends from the base of the beach as a nearly horizontal surface out to the reef margin (i.g., the upper edge of the reef face, a steep slope descending to deep water). An inner solid line in the figures represents the upper margin of the beaches. This line is drawn generally along a contour slightly above normal high tide level. A second solid line is drawn along a depth contour corresponding roughly to lower low water. These are unsurveyed lines and represent approximations from visual observations. Within the two "zones", dashed lines delimit areas of similar substratum type and/or biological facies. The letter symbols have the following meanings:

SD - sand deposit, generally above high tide
BD - rubble, cobble, and boulder deposits, generally above high tide
W - revetment stones placed as a wall at the shoreline
LB - beach rock
RB - cobble or shingle beach
SB - predominantly sand beach
LR - reef limestone surface; may be covered by a thin layer of sand
SR - predominantly sand bottom on the reef
BR - sheet deposit of rubble and boulders on the reef
S/BR - mixed bottom of sand, rubble, and boulders
LM - reef rock (limestone) margin of reef

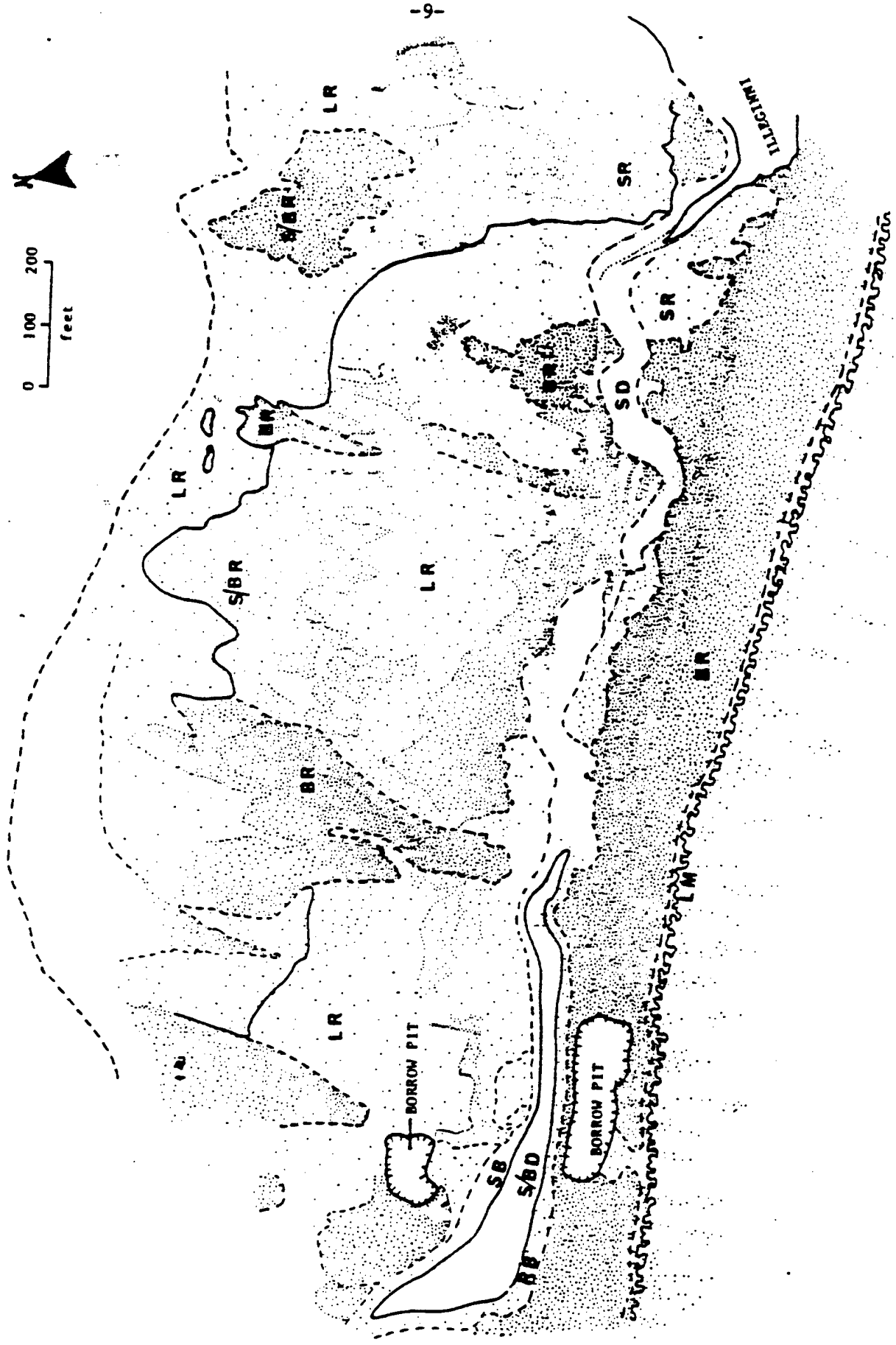


Figure 3: Interislet reef flat northwest of Illeginni.

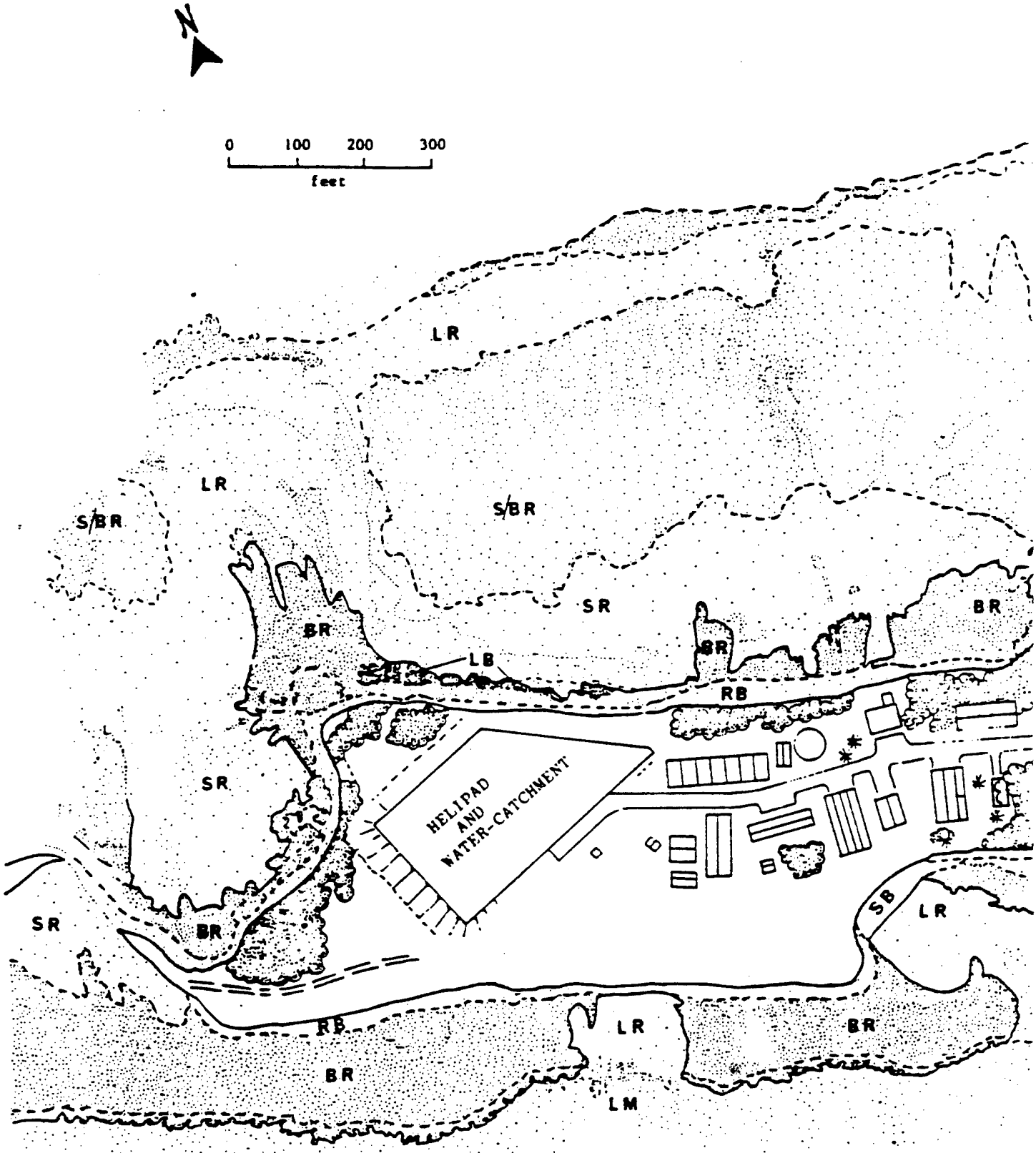


Figure 4: West end of Illeginni.

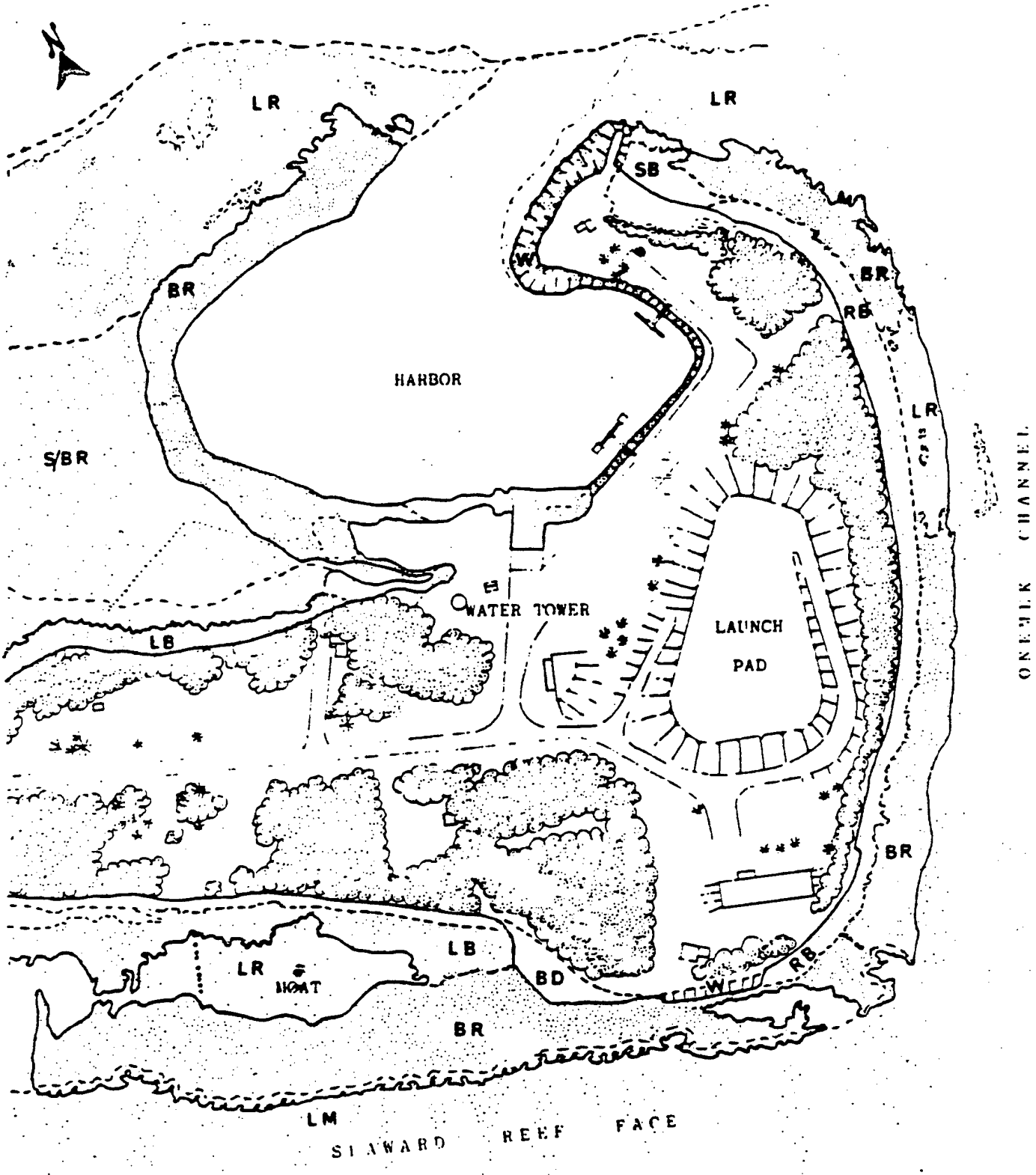


Figure 5: East end of Illeginni.

On the seaward side of Illeginni the reef flat limestone appears continuous with a sloping limestone surface (beach rock) at the shore (LB). On the West Onemak Pass reef the limestone extends from a shelf four to six feet deep at the reef edge to an irregular surface awash at lower low water, then to a gently upward sloping surface which disappears beneath a rubble beach at the shore.

The reef flat appears to present a continuous surface of indurated limestone (LR). A significant proportion of the limestone is covered with depositional material (sand, rubble, boulders) and is not visible by surface inspection. On the reef flat immediately behind the dissected seaward margin is a low sheet deposit of coral cobbles and boulders (BR). Width of this deposit is variable but on the order of 125 feet. The rubble extends as a continuous band from inside West Onemak Pass, along the front of Illeginni and the interislet reef to just beyond the quarry. Similar rubble sheets and tongues cover parts of the interislet reef flat. Rubble and sand deposits also cover areas on the interislet reef flat (SR; S/BR). The coarser deposits have resulted from storm waves (or storm surges) transporting material from the seaward face (reef slope) of the reef onto the reef platform. Rubble tongues are present as well along the lagoon shore of Illeginni and must have been deposited by powerful waves passing over the islet or at a time in the past when Illeginni did not exist as a fully emergent feature.

The reef flat lagoonward of Illeginni is covered with sand, rubble, and boulders (SR, S/BR) without evidence of an underlying indurated surface except along the outer one-third of its width.

Marine Ecology

Much of the reef flat surrounding Illeginni Islet is intertidal (littoral) or very shallow subtidal (upper sublittoral) and therefore a somewhat harsh environment presenting a rather barren appearance at low tide (see Figs. 6 and 7).

The shallow water area which is clearly an exception is the lagoon reef flat directly northeast of Illeginni Islet (Figs. 8 and 9). This area, as a consequence of slightly greater depth, supports a rich coral fauna and an abundance of fishes and reef invertebrates. Water circulation on this reef flat is promoted by wind-fetch waves moving across the broad Kwajalein lagoon from an easterly to northeasterly direction. Coral cover is high (estimated at 50% of the bottom) on the limestone bottom of the outer reef flat where the waves break at low tide and water currents have swept much of the substratum free of sand (Fig. 10). Cover by live corals is considerably less in the middle of the reef flat (estimated at between 10 and 15% of the bottom by ECI, 1977) where coral colonization is limited to rubble and boulders scattered over a sand and rubble bottom (Figs. 9 and 11). Losey (1973) obtained a value of 8% for coral cover along a 200-meter transect in this area. Coral diversity, however, is high in this zone. The inner portion of the reef flat, although still deeper than the level of lower low water, is inhabited by only a few species of corals (mostly *Porites, Heliopora,* and *Acropora* spp.), and cover is very low (5% to less than 1% in some areas). Water circulation appears poor in this area and many of the coral heads present (notably *Acropora* sp. and *Heliopora*) are periodically stressed or killed by unfavorable combinations of factors (as, for example, high rainfall during a period of exceptionally low tides).

Predominantly encrusting corals form a sparse cover on the shallow inter-islet reef flat (Figs. 2 and 3) northwest of Illeginni. A total of eight species were reported by Losey (1973) in a 125-meter transect across this reef in the vicinity of the quarry. At the seaward edge of the reef flat, coral diversity is high, with *Pocillopora verrucosa* the most conspicuous form on the projecting fingers of reef rock, but numerous encrusting hard corals and soft corals occuring in the sublittoral between reef rock fingers. Immediately seaward of

Figure 6. Seaward portion of interislet reef flat at low tide. Sand bars extend across the flat to a quarry in the distance.

Figure 7. Helicopter view of seaward half of interislet reef flat. Northwest tip of Illeginni appears in upper margin.

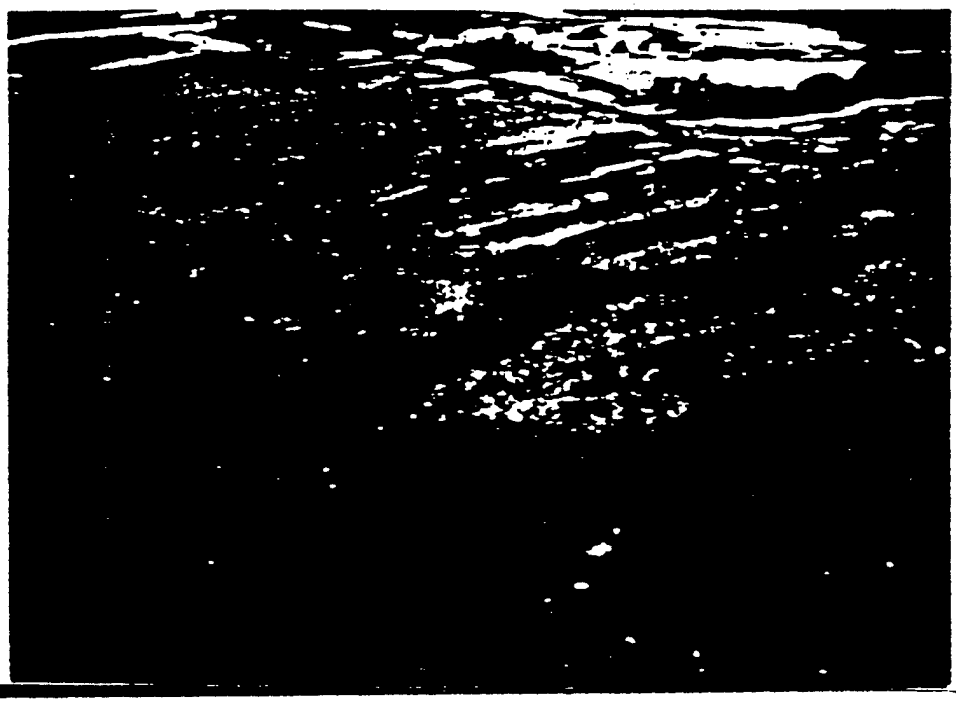


Figure 8. Helicopter view of lagoon reef flat north of Illeginni. Intended target area is among buildings at upper margin, center.

this area, rich coral growth was noted by Losey in shallow water on the reef front with *Acropora* and *Porites* predominating. Corals are slightly less abundant on the reef face immediately seaward of Illeginni than on the seaward reef face of the interislet reef, although both areas harbor rich coral growth. Coral growth on the seaward face was noted by Losey to be most luxurient at the West Onemak Pass end of Illeginni, and poorest around the old (probably Japanese) barge landing channel through the reef.

The reef face along the lagoon margin is a steep rubble slope supporting a rich assemblage of corals (Fig. 12). A 200-meter long transect conducted by Losey (1973) at an unspecified depth along the slope revealed 89 species of corals with an average cover of 44% of the bottom. This value ranks high in comparison with other sites at Kwajalein observed by Losey.

The distribution of species of crabs, molluscs, holothurians, and ascidians (invertebrates other than corals surveyed by Losey and ECI) demonstrates a poor differentiation of biotic assemblages between ocean and lagoon sides of the shallow reef platform. This fact may be attributed to the physical position of Illeginni and its platform reef. The dominant wind mode results in wind-waves approaching from the lagoon side rather than the open ocean side. The wind has a long fetch across the large Kwajalein lagoon. Thus, the lagoon reef experiences moderately large waves and a good wave-driven circulation. Further, ocean swells entering West Onemak Pass bend around the east end of Illeginni and are dissipated to some extent on the northeast (lagoon) reef. Consequently there is far less difference in the physical environment comparing seaward and lagoonward aspects than is the case on windward reefs (northeast to eastern side of Kwajalein Atoll) or on platform reefs of atolls with smaller or more enclosed lagoons.

Figure 9. Helicopter view of lagoon reef flat. Dark areas in foreground are live coral colonies. Intended target area is in upper right hand margin.

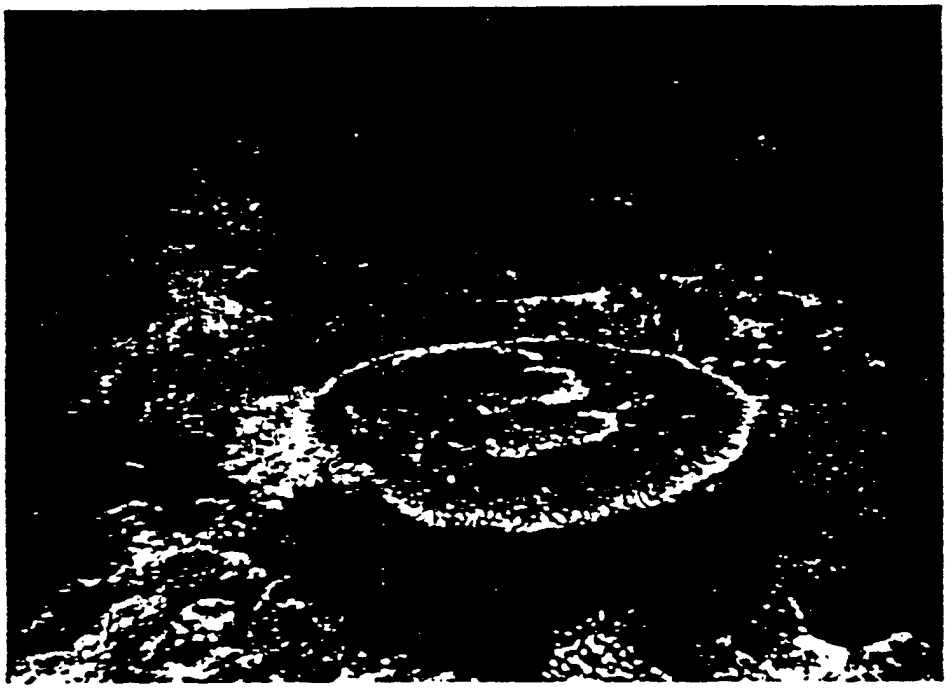


Figure 10. Rich coral growth dominated by *Acropora* on the gently undulating limestone bottom of the lagoon reef flat.

Figure 11. Mixed bottom of sand, rubble, boulders, and live corals on the middle portion of the lagoon reef flat.

The most numerous invertebrate on the interislet reef is a small, colonial ascidian. These ascidians are also abundant along the western side of the harbor. The most abundant invertebrate noted here by Losey was an unidentified cerithid gastropod (probably *Clypeomorus brevis*) found in densities of up to 1100 individuals per square meter. *Clypeomorus* was observed during the ECI study as widespread in distribution, but not abundant in any of the areas surveyed.

In the littoral boulder and rubble zones (BR), a small holothurian is common under stones on the seaward reef flat as well as along the lagoon shore of Illeginni. Crab (*Petrolisthes, Pachygrapsus*) and mollusc (*Pusiostoma, Strigatella, Morula*) species in this habitat also are distributed from ocean reef to lagoon shore areas. The acorn worm, *Ptychodera,* is present in sand in the seaward moat and on the lagoon reef flat. The large, edible top shell, *Trochus niloticus*, is abundant subtidally in the harbor (on revetment stones in the vicinity of the piers) and on the three foot deep shelf of the outer lagoon reef flat.

Littoral and supralittoral species, including molluscs (*Nerita plicata, Melampus* sp., *Clypeomorus brevis, Vasum turbinellus, Drupa ricinus, Siphonaria* sp.) and crabs (*Grapsus grapsus, Clibanarius corallinus, Calcinus laevimanus, Coenobita* sp.) occur on beaches around Illeginni and on the interislet reef flat generally, without obvious preference for "seaward" or "lagoonward" shores. Thus, at least for the littoral and shallow water fauna, both substratum type and depth relative to tidal parameters appear to be the primary determinants of biological assemblages in the marine realm at Illeginni.

The extensive areas of reef flat which uncover at low tide can be expected to harbor predominantly a transient fish population with numerous species moving onto the reef flat with the rising tide, and moving to subtidal areas of the reef flat and reef slopes at low tide. Only eels, abundant beneath boulders wherever shallow pools of water remain at low water, are present at all states of the

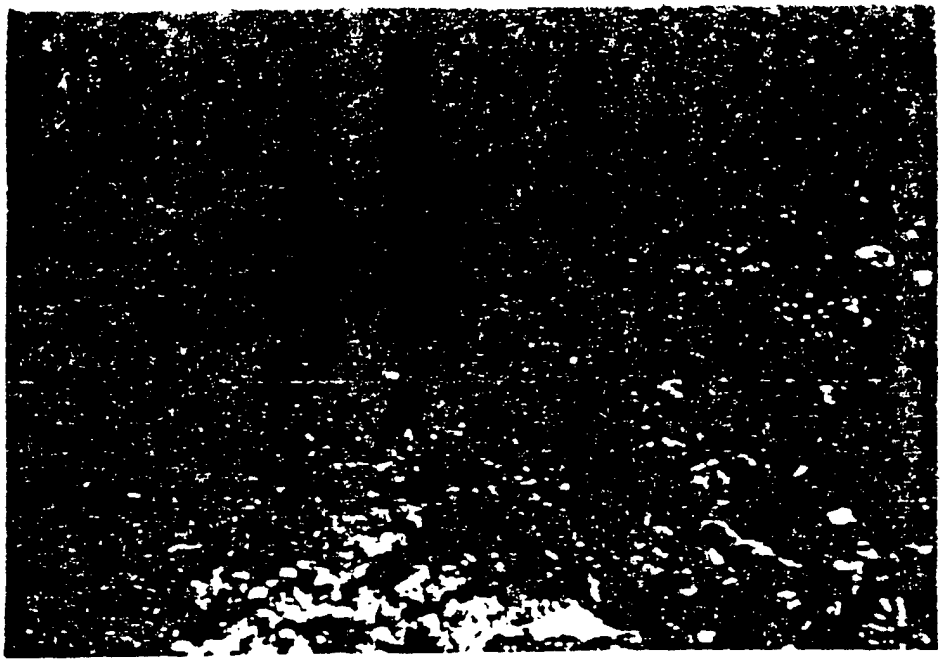


Figure 12. Talus slope with rich coral growth on the lagoon reef face.

Figure 13. View of seaward reef flat at Illeginni showing shallow moat (right of center) on rising tide. Intended target area is at far end of moat.

Figure 14. *Pisonia* forest from the south. Largest trees are *Pisonia grandis*, with a border of *Tournefortia* in front. Open field is covered with the vine, *Ipomoea pes-caprae*.

tide. Reef fishes are abundant on the subtidal, lagoon reef flat, although concentrated in the outer half and along the reef front at low water. A total of 40 species of fishes were recognized along a lagoon reef flat transect conducted by Losey (1973), with 219 individuals counted within a designated area of 800 square meters. However, several species (*Acanthurus nigrofuscus, A. olivaceus,* and *Pomacentrus vaiuli*) were present in numbers "too numerous to count" and therefore given a maximum count of 25 individuals. Also listed as very abundant (more than 50 individuals in the transect area) in this survey were the Acanthurid (surgeonfish), *Ctenochaetus striatus,* the Labrids (wrasses), *Halichoeres margaritaceus* and the scarid (parrotfish), *Scarus sordidus.*

A transect on the lagoon slope revealed 630 individuals representing 130 species of fish. Again, a number of species (*Acanthurus glaucopareius, A. thompsoni, Ctenochaetus striatus, Holocentrus samara, Thalassoma amblycephalas, Oxymonacanthus longirostris, Chromus caeruleus, C. dimidiatus, C. leucurus, C. ternatensis, Pomacentrus jenkinsi, P. tracyi, P. vaiuli, Scarus sordidus,* and *S. cenosus*) were present in numbers "too numerous to count".

Macrothallic algae are rare in shallow-water areas of the reef flats. Few macrothallic species would be expected to thrive on littoral surfaces, except perhaps where periodically wetted by waves. Nonetheless, a biological transect conducted by Losey across the interislet reef flat revealed a total of twenty-two algal species, mostly, however, microscopic encrusing or filamentous forms. The larger forms to be found on the reef flat occur in crevices and around the lower margins or boulders, presumably where protected from large grazing fishes. A notable exception is *Asparagopsis taxiformis,* which covers the two to three meter deep shelf along the West Onemak Pass side of Illeginni. The dominant alga in the coral-rich zone of the lagoon reef is *Halimeda opuntia.* Specimens of *Udotea palmetta* are present in this area. On the seaward reef flat, *Codium*

edule and *Codium arabicum* are frequently encountered. An inconspicuous, creeping alga, *Caulerpa urvilliana,* is found on the reef flat near low water level along West Onemak Pass, and lagoonward of the quarry on the interislet reef flat. Areas of sandy bottom harbor filamentous cyanophytes (blue-green algae).

Terrestrial Vegetation

Recovery of vegetation on Illeginni since the period of heavy construction and grading in 1970 through 1972 and subsequent abandonment of most facilities on the island in late 1973, has been substantial. Viewing the terrestrial environment on Illeginni in late 1972, Losey (1973) stated: "Most of the island was either barren or covered with weedy growth or unnatural vegetation. Thirty-eight species of plants were found of which 70 percent could be considered natural." Excepting buildings and paved areas, a carpet of vegetation now covers nearly all of the island, a recovery which attests to the relatively high rainfall received by the island (103 inches annually; Taylor, 1973). The present distribution of vegetation types (from ECI, 1977) is shown in Figure 15.

In 1972, Losey observed that "little effort was being made to use natural plants for revegetation rather than introduced species". However, the natural process of revegetation following cessation of activities on Illeginni has favored native plants. Introduced ornamentals and weedy herbs, the latter largely confined to open meadowland, would appear to be on the wane. Although open-field growth remains over much of the cleared land, these areas are dominated by *Eragrostis whitneyi* (a native, central Pacific grass) and/or *Fimbristylis cymosa* (a pan-tropical species). Both are low-growing and unable to compete with *Ipomoea* or *Vigna marina,* scrambling vines which present a nearly solid ground cover in many of the open areas on Illeginni. One introduced weed, *Conyza canadensis,* is widespread over the island in open areas, as are several other low-growing species. Introduced weeds are particularly prominent on the

slopes of the launch pad. A few, small *Tournefortia* and *Scaevola* trees have become established on the slopes, and, as in other open areas, represent encroachment of scrub growth which eventually will cover most of the present open field growth.

The most ubiquitous scrub species on the islet are *Scaevola taccada* (beach naupaka) and *Tournefortia argentea* (tree heliotrope), the latter growing into a moderate-size tree. Both are widespread atoll species. *Scaevola* is most often seen around the coastline or as young plants encroaching on open areas. *Tournefortia* is ubiquitous, occurring mixed with nearly every woodland type on the islet. *Tournefortia* often occurs mixed with *Guettarda speciosa* and *Pandanus tectorius*. Frequently, *Tournefortia* forms a border around or inland of the other woodland types described below.

A nearly pure stand of *Pemphis acidula* borders much of the lagoon shore. These trees are exceptionally tall (approaching 7 meters). Young *Pemphis* trees occur in scattered locations; one group on the lagoonward margin of the helipad indicates expansion of this woodland type.

The *Pisonia* forest was noted by Losey (1973) as "...in poor condition and ...probably insufficient in number [of trees] to maintain the habitat". In view of the great ability of *Pisonia* to reproduce vegetatively, the idea on a minimum number of trees necessary to "maintain the habitat" is unfounded. The core area of the forest (Fig. 14), west of the launch pad, appears to be healthy, and young trees present attest to expansion into cleared areas. Several trees occur outside of the forest stand (Fig. 15).

Several species of shrubs and trees occur in scattered locations on the islet. For the most part, these do not constitute distinct forest types. Thus, *Guettarda speciosa* is widespread, frequently mixed with *Tournefortia*. Many of these trees are young and *G. speciosa* may eventually become one of the

Figure 15 (opposite). Distribution of vegetation types on Illeginni Island, Kwajalein Atoll. Key to symbols:

Herbaceous communities

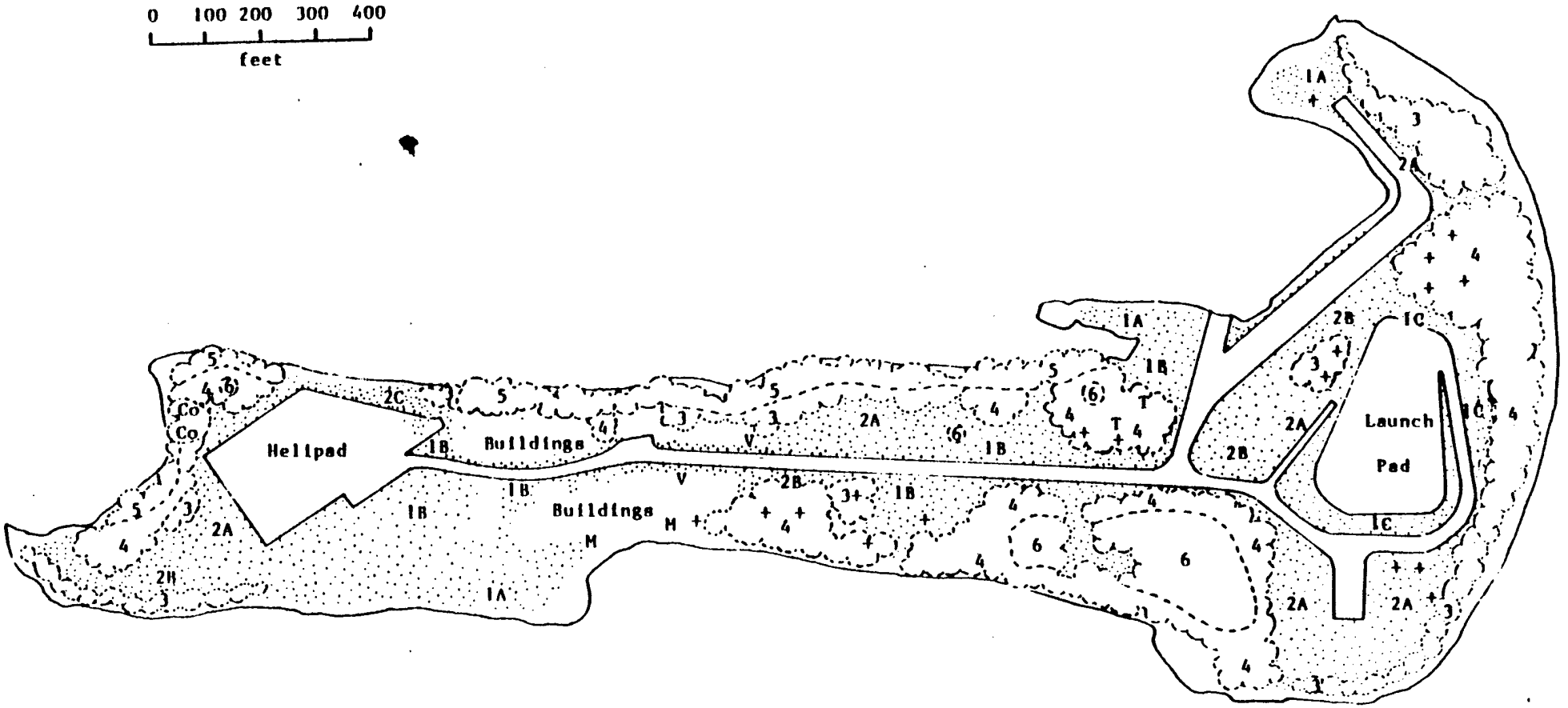
- 1A - sparse growth of sedges (*Fimbristylis*) and/or grasses (*Eragrostis*) and low weedy species
- 1B - high cover of *Eragrostis/Fimbristylis* with *Conyza canadensis* and low weedy species
- 1C - tall weedy species: predominantly a grass (?*Paspalum*), *Conyza*, and *Eclipta*
- 2A - *Ipomoea* (scrambling vine)
- 2B - *Vigna* (scrambling vine)
- 2C - *Triumfetta* (scrambling vine)

Scrub and forest communities

- 3 - *Scaevola/ Tournefortia* scrub
- 4 - *Tournefortia*, usually with *Guettarda* and *Pandanus*
- 5 - *Pemphis*
- 6 - *Pisonia*

Co, M, T, V, 6, + isolated trees or shrubs

- Co - *Cordia*
- M - *Morinda*
- T - *Terminalia*
- V - *Vitex*
- 6 - *Pisonia*
- \+ - *Cocos*


0 100 200 300 400
feet
Helipad
Buildings
Buildings
Launch
Pad
1A
1B
1C
2A
2B
2C
3
4
5
6
Co
V
M
T

dominant forms on the islet. This species was not recorded by Losey (1973) from Illeginni. A few *Morinda citrifolia* (Indian mulberry) occur seaward of the main cluster of buildings in the middle portion of the islet. An introduced ornamental shrub, *Vitex trifolia* var. *variegata*, is present around some of these buildings. Two large *Cordia subcordata* (kou) are growing at the northwest end of the islet, and several *Terminalia litteralis* (= *T. samoensis*) occur near the water tower.

Coconut trees (*Cocos nucifera*) are widely scattered over the islet. Many of these are young and presumably were planted during the period of KMR occupation. Remnants of the former coconut plantation extend in a discontinuous belt from east of the more seaward cluster of buildings, across the road to an area southwest of the water tower, and thence along the northern side of the launch pad.

Terrestrial Fauna

The terrestrial fauna of Illeginni has not been extensively surveyed. The island is inhabited by several species of sea birds, the most abundant (in October 1977) being white-capped noddies (*Anous tenuirostris*) and fairy terns (*Gygis alba*). The noddies, in particular, are concentrated among the *Pisonia* trees, where they roost and nest. Rats and mosquitoes are abundant on the island. Terrestrial hermit crabs of the genus, *Coenobita*, are unexpectedly rare.

Threatened Species

No threatened (rare or endangered) species were encountered in either the marine or terrestrial surveys at Illeginni Island. The "microatoll" area of the lagoon reef flat directly to the northwest of Illeginni has been described by Losey (1973) as unique for Kwajalein in having a rich fauna in

shallow water. The 1973 study also concluded that the reef slopes surrounding Illeginni are exceptionally rich in diversity of corals and fishes.

Historical and prehistorical man-made structures

During the period of U.S. military activity on Illeginni from 1972 to 1973 much of the island's surface was altered by grading. Low scrub growth was cleared from forest stands not leveled during construction activities. These extensive modifications of the island's surface probably destroyed any archeological sites present. The National Register of Historical Places was consulted and there are no registered sites on Illeginni Island. A cluster of four clearings directly northeast of the launch pad and located within a grove of very old coconut trees was pointed out as possibly representing evidence of Marshallese occupation, although aerial photographs taken during the period of base construction suggest these clearings were created at this time. Prior to leasing of the island by the U.S. Government, the island's owners visited the island to harvest coconuts, but did not reside there.

Base facilities constructed on the island for testing SPRINT and SPARTAN missles included a launch pad (a flat topped earthen mound some 31 feet in height), a harbor with personnel and fuel piers and boat ramp, a water tank and a water tower, a combination helipad and water catchment surface, and a number of temporary, semi-permanent, and permanent buildings. Many of the temporary buildings have since been removed from the island. Security has been maintained on some of the permanent structures associated with the launch pad. The cluster of buildings in the western half of the island are considered an integral part of the proposed RV test program.

LAND-USE RELATIONSHIPS

The proposed action of targeting RV's for impact upon Illeginni Island is consistent with land-use plans, policies and agreements between the United States and Trust Territory governments. The Kwajalein Missile Range has been designated a "National Range" by the Secretary of Defense in Department of Defense Directive Number 3200.11. The defined mission of a "National Range" is to "Provide a broad range and test support base to aid Department of Defense agencies responsible for development, test, evaluation and operation, as applicable, of material and weapon systems, and to other Federal Government Agencies having need for that support." The proposed action constitutes a test of a U.S. military weapons system.

The Mid-Atoll Agreement (Dec. 18, 1970, ammended in 1975) provides that compensation be paid by the U.S. Army to the Trust Territory government which shall in turn pay inhabitants who have been displaced from the Mid-Atoll Corridor area of the Kwajalein Missile Range (Figure 1). This document provides that compensation shall commence on 1 February 1971 on a semi-annual basis and continue thereafter "...until the Army or any of its successors allows the People to permanently return to the area". Compensation being paid as a result of:

> The inconvenience and disruption caused by the relocation of the People; the change of their normal and customary living habits; the relocation of the individuals in an environment foreign to that to which they had become accustomed; compensation for loss of copra income and the loss of customary and traditional fishing rights in the Area; the requirement of living in a more populated and dense society; and their obligations to enter into the Area only with proper permission and to vacate said Area as and when requested by the proper authority.

The Mid-Atoll Agreement further provides that upon the eventual permanent return of the inhabitants to the affected area "...the Army or its successor agrees to provide to the Trust Territory the necessary support needed to

assure the orderly transportation to the islands of residence of those persons with rights to return." Further, "Upon determination that the residents may return to the Area, the Army shall initiate prompt negotiations with the Trust Territory for the building of up to thirty (30) dwellings..." and that "The Army or its successor shall provide assistance in land clearance and agricultural aids..."

The proposed action is an extension of U.S. Government activities on Illeginni. Responsibilities encumbered by the U.S. Government under the Mid-Atoll Agreement were assumed when Illeginni was included in the Mid-Atoll Corridor. The proposed action is consistent with the terms of the Mid-Atoll Agreement and does not alter or extend U.S. Government responsibilities to the Marshalese people and/or the government of the Trust Territory.

The proposed action is consistent with the lease agreement between the United States and Trust Territories (23 January 1970) which states that "...United States may cut and remove trees and vegetation and may otherwise alter Illeginni Island, excluding dredging as it may see fit without compensation to Trust Territory or the legal owners of Illeginni Island; Provided, however, the United States shall be discriminate in any cutting or alteration". The proposed action will have no permanent or long-term adverse effects on future (undetermined) land-use plans or policies. Destruction of certain, specified facilities may be undesirable (see page 35).

The island is uninhabited and all structures, with the exception of a communications station, have been abandoned and are in various states of disrepair. Relocation of the Illeginni communications relay station (unmanned) would be necessary to prevent the possibility of its destruction, and subsequent disruption of some KMR communications, during the test program.

Estimated costs of relocation have been put at $350,000. by the Pacific Ocean Division of the U.S. Army Corps of Engineers.

PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

The major environmental disturbance resulting from the proposed action will be the destruction of a limited area where the RV impacts on the island or in the shallow marine environment. A crater may be formed in the impact zone, and parts of the RV could be scattered over some wider zone. The total number of RV's targeted on Illeginni will depend, in part, on the success of the initial tests. RV's which miss the island or reef flat will result in a need for additional tests. These off-target RV's will not have a negative effect on the island ecosystems, although deposition of unrecovered RV fragments in deeper water of the reef environment may be undesirable.

Precise coordinates of the target area are classified. Intended zones of impact are within the cluster of buildings just west of the center of Illeginni Island and on the seaward reef flat within 150 feet of the shoreline (Fig.16). The probability of impact within this area has been given on page 2, and suggests much of the island may be at risk to off-target impacts. In addition, the extent of destruction resulting from an impact and contact with material scattered from the impact site can, at present, be envisioned only in general terms. Consequently, determination of environmental degradation is provisional to the extent that damage reports following each test should be utilized to assess the impact of additional tests.

Terrestrial and shallow water marine environments at Illeginni have been ranked (zones A, B, and C) to indicate the degree of negative environmental impact which could result from an RV crash. An RV impact within an area designated "A" can be expected to cause the most serious negative environmental effects, whereas areas designated "C" are essentially under

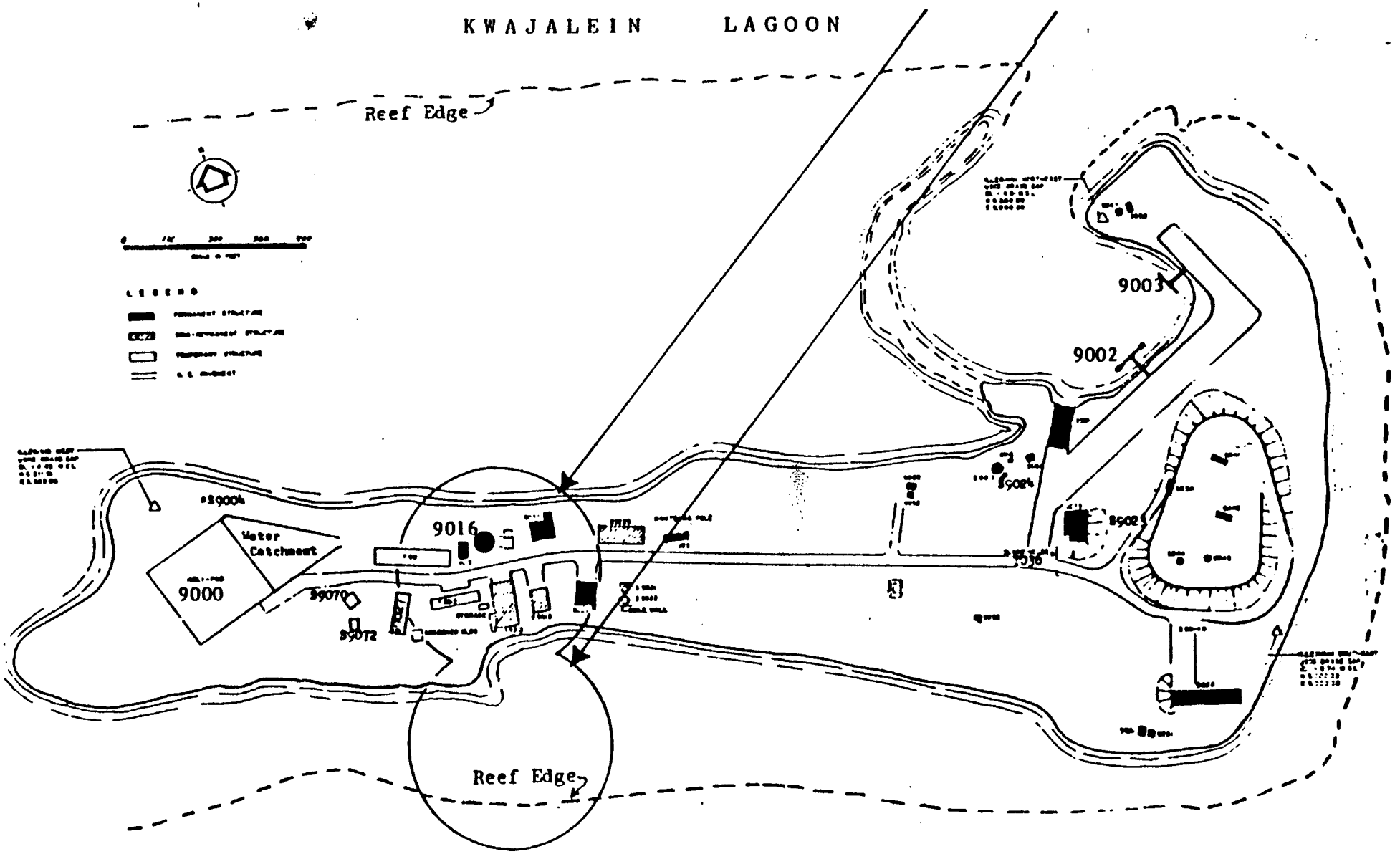


Figure 16. Illeginni Island showing existing structures, approximate target areas, and approximate ground track trajectories from Vandenberg AFB.

little or no threat of negative environmental effect from the proposed action. Each of the designated zones is outlined in Figures 17 and 18, and these are discussed below.

Terrestrial Zones

Terrestrial zones designated "A" encompass the *Pisonia grandis* forest and an area at the west end of Illeginni containing *Pisonia* trees and two large *Cordia subcordata* trees. The *Pisonia* forest is a desirable forest-type, "preferred" by resident sea birds for roosting and nesting (see Hatheway, 1955). *Pisonia* is one of the largest of trees native to low coral islands, usually occurring in pure stands (or sometimes mixed with *Ochrosia* in the Marshalls) and representing a climax community. *Pisonia* is restricted in its natural distribution to low coral islands (Shaw, 1952). These forests have been extensively cleared on inhabited islets for coconut plantations (Taylor, 1950; Hatheway, 1953; Niering, 1956; Catala, 1957). Although perhaps not a "threatened species", the loss of *Pisonia* forests over the Pacific has probably had a negative impact on populations of sea bird species associated with this forest type. Further, there is evidence that the sea bird-*Pisonia* association is an important one in the cycle of chemical nutrients from the sea to the land on coral islands (Fosberg,1954). It is unlikely that a single RV impact in zone A would destroy the *Pisonia* forest on Illeginni. *Pisonia* has remarkable abilities to regenerate from stumps and fallen trunks, an adaptation to infrequent damage from hurricanes (= typhoons). However, the set-back in terms of time to recover is greater for this forest area than any other vegetation type on Illeginni.

The second zone "A" designated on Illeginni is located west of the helipad and encompasses a locally dense, mixed forest of *Tournefortia, Pandanus, Pisonia,* and *Cordia* trees. *Pemphis* trees line the adjacent

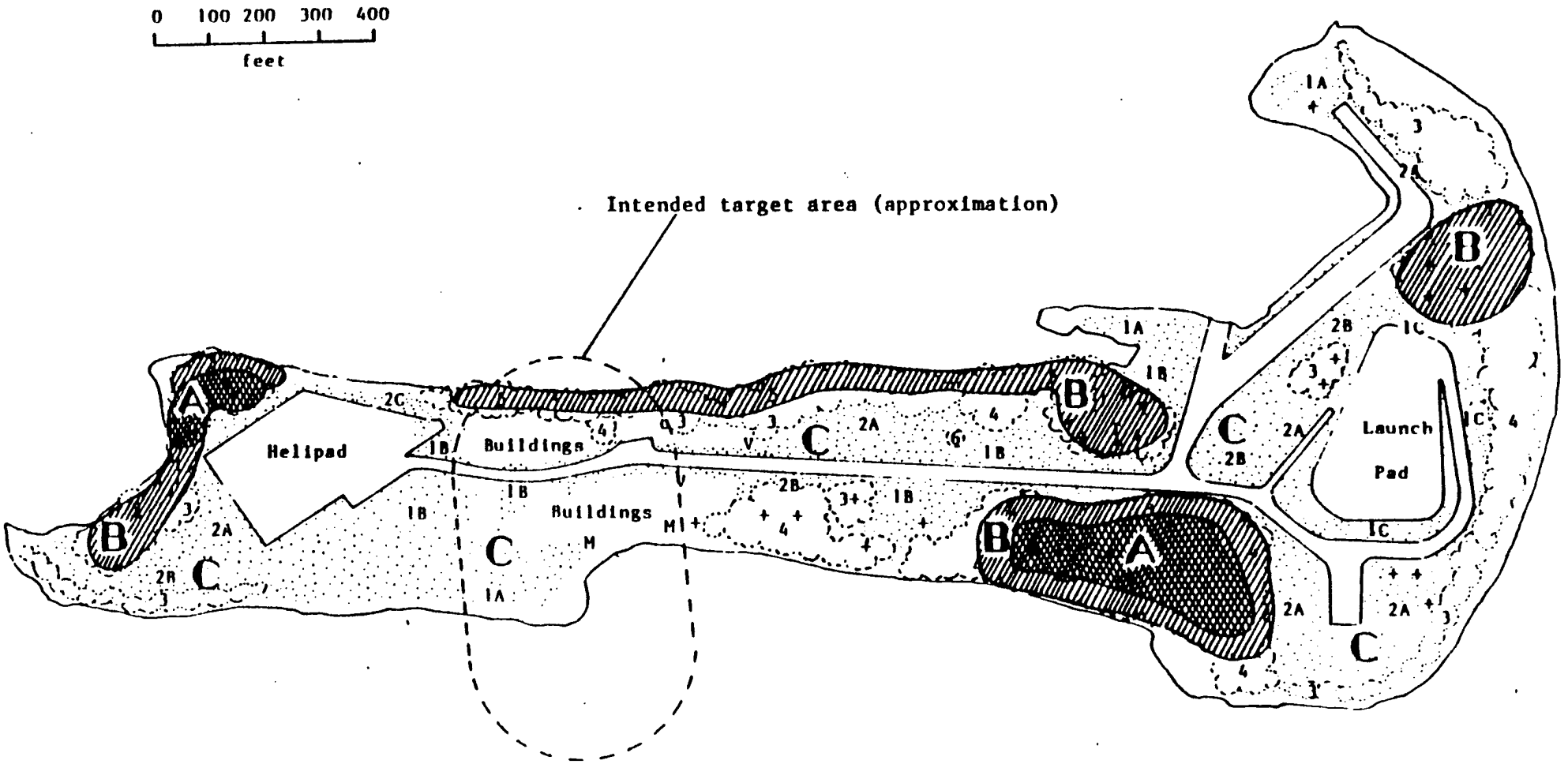


Figure 17. Terrestrial environments on Illeginni ranked by degree of probable negative impact (A - high probable negative impact; B - moderate probable negative impact; C - little or no probable negative impact).

shoreline. *Cordia* is a large spreading tree, probably indigenous to the region (or an aboriginal introduction), and valued for its shade and wood by native populations (see Neal, 1965).

Terrestrial zones designated "B" correspond with well established trees or forest types: *Pemphis* along the lagoon shore; *Cocos*, or *Tournefortia* in the interior. Also included are isolated occurrences of *Terminalia*, *Pisonia*, and *Pandanus*. Single RV-impacts in these areas can be expected to destroy some trees, thus having a negative effect on the local environment. Most of these species are widespread over the island, and therefore a distinct habitat-type would not be destroyed. Full recovery can be expected to occur in a matter of one to perhaps five years.

Zones designated "C" include open field or meadowland growth and scrub growth. Local destruction of the habitat over a limited area would result as a consequence of RV-impact, although complete recovery should follow in less than one to no more than several years.

Marine Zones

Marine zones designated "A" encompass subtidal reef margin environments rich in coral growth. The contribution of corals to tropical marine ecosystems is well documented and need not be detailed here (see for example, Wells, 1957; Weins, 1962). Destruction of areas of rich coral growth is undesirable. Recovery of the benthic community where this community is dominated by live corals would be slow (on the order of several years to a decade or more). This time span is considerably longer than would be the case in other benthic communities at Illeginni and therefore is a major consideration in designating such areas as having a high probable negative impact. Nonetheless, a single RV impacting in zone A would result in local or limited destruction which would not be permanent because neither the

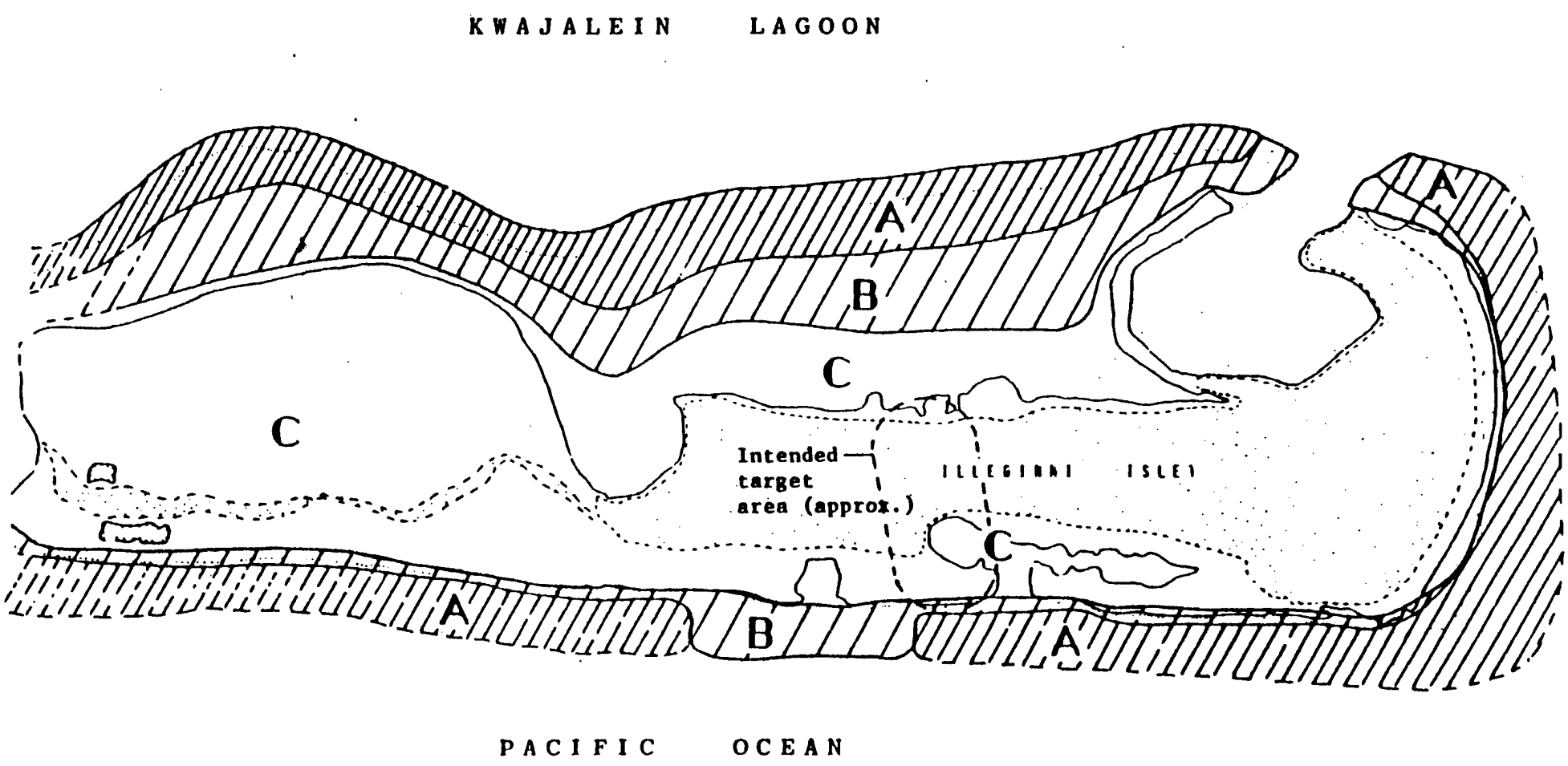


Figure 18. Marine (reef flat and reef margin) environments on Illeginni ranked by degree of probable negative impact (A - high probable negative impact; B - moderate probable negative impact; C - little or no probable negative impact).

nature of the substratum nor other physical or chemical properties of the local environment would be permanently altered.

Areas of moderate coral cover are designated "B" zones. Live corals cover considerably less of the substratum in such areas as compared with "A" zones, and therefore, overall damage would be less. Alteration of the bottom may result owing to the presence of mixed substrata (i.e., sand, rubble, boulders). Craters created by the RV can be expected to fill back in with predominantly fine sediments (silt and sand) and thus contribute to a "permanent" alteration in the local habitat. However, destruction of local occurrences of hard bottom providing cover for fishes and a suitable surface for coral colonization would be minor when viewed in the context of the limited area involved.

Zones designated "C" are predominantly intertidal or very shallow subtidal, with no or low coral cover. The benthic communities inhabiting these areas are dominated by cryptic invertebrates. The physical rearrangement of a local area of bottom will have no long-term adverse effect on these communities. Waves and swells generated by storms affect a far greater area of bottom than would any reasonable number of RV impacts. Cratering may have the positive effect of creating "tide-pool" habitats serving as refuges for organisms poorly tolerant or intolerant of exposure at low tide and in this manner could increase local biotic diversity (see Losey, 1973, p. 87-88 on possible positive effects of borrow pits on barren reef flats).

Effects Related to Intended Targets

The intended target areas on Illeginni (Fig. 16) are favorably situated with respect to minimizing negative environmental effects. The environmental impacts discussed below notwithstanding, on-target RV impacts will cause no serious degradation on Illeginni or in the nearshore marine environment.

SOUND

Noise generated by the impact of an RV on Illeginni will be impulsive and of short duration. Because of the isolated location of the island, no adverse effects on human populations will occur. Temporary disturbance of nesting birds on the island will not be serious.

LAND AND WATER QUALITY

Three aspects of an RV impact need be considered: cratering, RV fragments, and chemical contamination.

Impact Craters

If the RV remains intact and does not ricochet or "skip" on impact, penetration depth of the RV through a coral (reef) formation (Fig. 19C) is predicted to be about 14 feet (Rogers, 1977). A depth of water of at least 10 feet over the reef formation would not significantly reduce penetration into the reef (Fig. 19D). The penetration of the RV on a terrestrial environment (assuming a top sand layer underlain by relatively thin solid coral with a weathered coral below these layers) is estimated to be between 22 and 25 feet deep (Fig. 19B). Deformation or breakup of the RV on impact would significantly reduce the penetration.

The impact of targeted RV's with the ground can be expected to create a crater of some dimension. Because of the RV velocity at impact, cratering should be minimal. On much of the reef flat, hard (limestone) bottom is exposed at the surface or overlain by a shallow deposit of sand, rubble, or boulders. Overlaying sedimentary deposits would probably be scattered away from the impact point. In time, these materials will be redeposited by waves and/or water currents in the affected area. Small craters remaining on the reef flat could contribute to a local increase in biotic diversity by enhancing the complexity of the physical environment (see page 35).

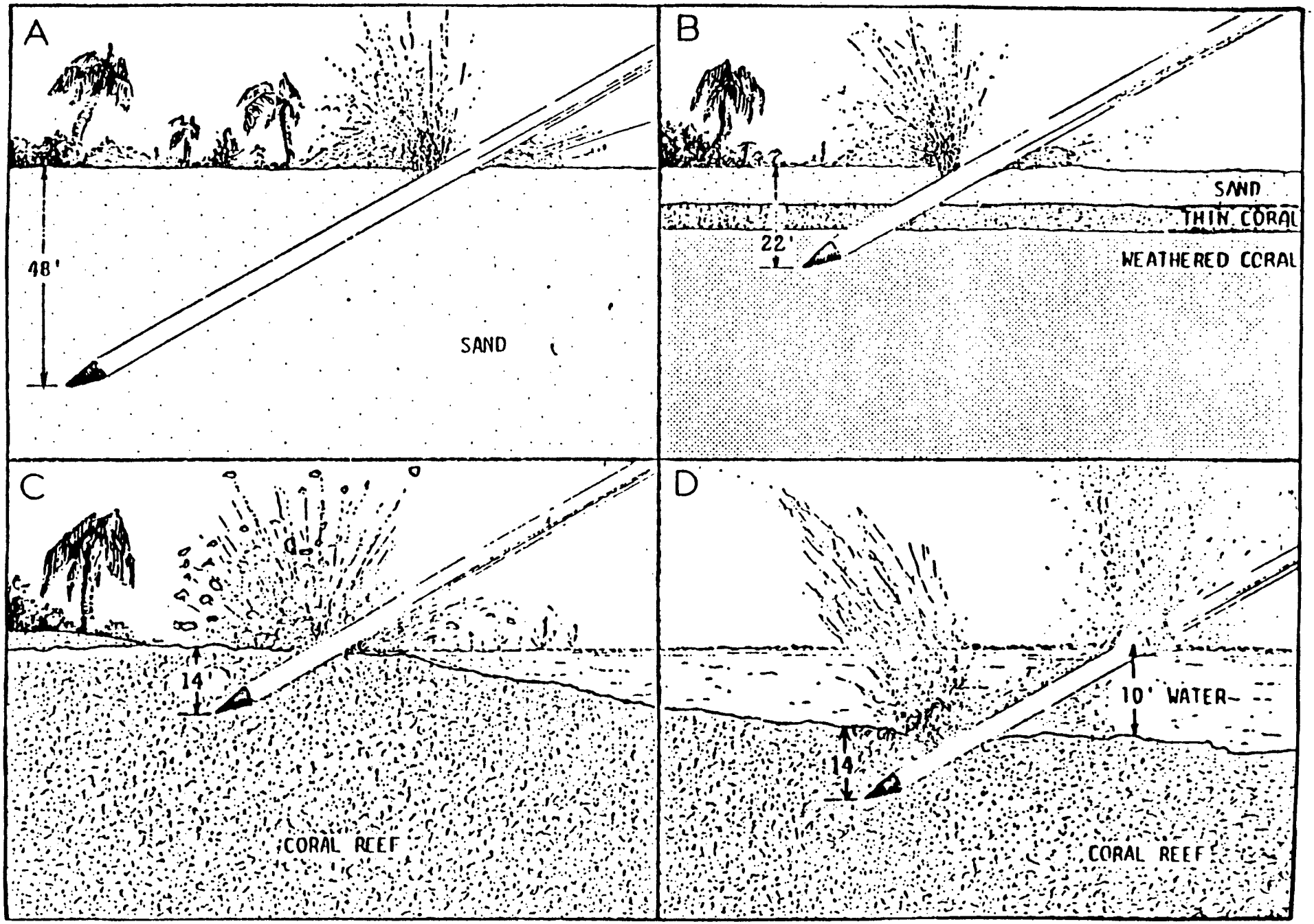


Fig. 19 Predictions of RV penetration (after Rogers, 1977). Predictions based on integrity of RV (i.e., maximum depths attained if RV remains intact on impact). Cases B and C best represent situations

Cratering can also be expected from land impacts. In beach areas cratering would be of little consequence, and realignment of the shoreline to its original form would be accomplished by wave action. Cratering in the terrestrial environment might result in undesirable depressions exposing the water table or altering the physicochemical environment and interfering with recovery of the vegetation. Temporary or permanent "ponds" would be breeding areas for mosquitoes and contribute to loss of fresh or brackish ground water during dry periods.

Re-entry Vessel Fragments

Upon impact, the RV may break up into fragments which will be scattered over the ground and/or reef. On land, this debris will constitute a visual degradation of environmental quality. On the reef, the debris may cause local degradation in water quality by providing sources of heavy metal input to the marine environment through sea water solution processes. Certain exotic metals and copper are of particular concern (for specific toxicities, see McKee and Wolf, 1973).

Chemical Contamination

The MOD 5T RV contains 402.5 cc of potassium hydroxide (KOH) which may be spilled over the reef flat and/or land upon impact or leak from the wreckage following impact. Potassium hydroxide is a caustic substance which can result in damage to living organisms (either on the reef or on the land). However, the quantity of KOH present in an RV is regarded as insufficient to cause damage over a wide area.

SOCIOECONOMIC IMPACTS

Illeginni is under lease to the U.S. Government, is uninhabited, and all man-made structures and buildings on the island are the property of the U.S. Government. The primary objective of the proposed action is to test arming

and fusing systems in a land impact environment with trees and buildings. Destruction of some of the existing structures can be expected to result from the proposed action. However, several of the permanent structures (see Fig. 16) appear to have potential socioeconomic value if and when the island is returned to the owners or utilized by KMR as a base of operations in the future. These are a cement water tank (facility No. 9016, potable water storage tank), two piers (facility No. 9002, barge pier, and No. 9003, personnel pier), and the helipad-water-catchment surface (facility No. 9000).

All structures, of course, may be disposed of at the discretion of the U.S. Government. Nonetheless, value of any facility must be reckoned from the standpoint of intended use, expected life, and potential use. The permanent structures described above appear to have a long usable life and be of potential value if rehabitation of the island is planned. Destruction of these facilities must be regarded as a negative impact in the socioeconomic sphere. Admittedly, a negative impact based on unspecified, future circumstances is, in effect, only a potential negative impact. Further, the probability of destruction of these facilities is not great (only facility No. 9016 is within the intended target area). It may be argued that destruction of other buildings, of a permanent or non-permanent type, might constitute, by such reasoning, a negative impact as well. However, these other structures have served their useful purpose, and options on future use are far less certain than with the structures listed above.

There is evidence of persons unknown returning to the Island to harvest coconuts and the edible top-shell, *Trochus niloticus*. According to the Mid-Atoll Agreement, the Marshallese owners do have the right to return to the Island during certain periods of the year. Mature coconut stands are outside of the intended target areas. *Trochus* is harvested from the harbor revetment stones, although the population of this mollusk also extends along

the lagoon margin of the reef flat. The proposed action will have no detrimental effect on these resources. Off-target RV's may damage or destroy a small number of coconut trees. Reparations or replacement for any such loss would best be considered at the time of, and within the context of, negotiations with the land owners upon termination of U.S. Government use of Illeginni (see provisions of the Mid-Atoll Agreement discussed herein, p. 26-27).

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the proposed action are limited to relocating the target area. Thus, it might be possible to select another island or to create an artificial island as a target and still meet the test objectives. In selecting a target the following considerations need be taken into account: (a) the island should be uninhabited; (b) buildings and trees should be present to meet test objectives; (c) operational and/or otherwise valuable fixed instrumentation and structures should not be present; (d) the island should be positioned such that the angle of RV entry would cause the missile to fall into the ocean as opposed to the lagoon if there is an overshoot or the missile skips on impact; (e) electric generators and photographic vantage points should be present. These considerations are essentially an expansion of criterion (1) on page 1. Illeginni meets all of the above criteria except (e). No other island at KMR meets more than two or three of these criteria. Further, the environmental impact of RV tests on another islet at Kwajalein would not differ substantially from those identified for Illeginni. Few locations in the Pacific outside of KMR meet the basic criteria listed on page 1. Again, however, transfer of the project to another island (e.g., Canton or Enderbury in the Phoenix Group) would not substantially reduce negative environmental effects. Indeed, negative impacts might be increased.

Relocating intended target zones on Illeginni is another alternative action. With respect to the land impact area, the site selected presents the greatest concentration of buildings and therefore best meets the test objectives. Further, as noted on page 35, this area is favorably situated for minimum negative environmental effects. On the other hand, shifting the reef impact area to a location on the interislet reef flat northwest of Illeginni (between Illeginni and the quarry) would have the favorable consequence of reducing the risk of off-target RV impacts in zones of high probable negative impact. This change,

however, would alter stated test objectives. The reef and land target areas (Fig. 16) are mutually interdependent and it would not be practical to relocate the reef target without moving the entire complex (SAMTEC, Vandenberg AFB, 1978).

Construction of an artificial islet for the purpose of RV targeting is not recommended as a realistic alternative to the proposed action, because the negative environmental effects associated with construction would certainly exceed those associated with the RV impacts. It has been estimated by the Pacific Ocean Division of the U.S. Army Corps of Engineers that the cost of constructing an artificial islet in the quarry area northwest of Illeginni would be approximately $300,000.

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CAN NOT BE AVOIDED

The adverse environmental effects discussed in the section on Probable Impact of the Proposed Action on the Environment are unavoidable to the extent that some degree of damage to the natural environment will occur upon impact of the RV with the terrestrial or reef environments of Illeginni. Altering the location of intended target zones and, at the same time, meeting test objectives, would not substantially mitigate adverse effects. Rather, adverse effects might be increased.

A precise determination of adverse environmental effects of the proposed action is made difficult by the several unknowns attendant to the project. For example, the total number of RV tests is estimated at seven but could be less (three tests are initially planned), or more. Further, the extent of habitat destruction and environmental degradation resulting from each test is understood in general terms only. For these reasons, it has been stated (p. 29) that an environmental assessment must be provisional. The extent of this provision requires clarification.

Within the intended target zone, and in fact, within all zones (terrestrial or shallow water marine) designated "C" in Figures 17 and 18, the expected result of RV impacts would have no or only minor negative environmental effects. Mitigative actions discussed below will satisfactorily offset most or all of the negative environmental impacts. Partial or complete destruction of potentially useful facilities (see page 39) should not be compensated for because of the unspecified (unplanned) nature of future use and because these facilities are the property of the U.S. Government.

MITIGATION OF NEGATIVE ENVIRONMENTAL EFFECTS

Impact Craters

Craters created on the reef can not be mitigated. Natural, physical

forces will, in time, refill these areas. In the interim they may serve as refuge areas for certain subtidal organisms, and may become biologically more diverse than surrounding littoral areas. Craters on the land should be inspected to determine if, by their size, they constitute a detriment to recovery of the original vegetation. Larger craters (particularly those exceeding a depth of two feet) should be refilled. If "releveling" of the ground surface appears desirable, this should be accomplished in a manner least damaging to surrounding, unaffected areas (e.g., by hand labor rather than grading machinery in forested areas). Funding for this action is available (SAMTEC, Vandenberg AFB, 1978).

Re-Entry Vessel Fragments

A reasonable effort should be made to remove all RV debris in accordance with KMR recovery policies (PRD A1A05).

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The adverse environmental effects of the proposed action on Illeginni Island are expected to be localized and of relatively short duration. Although these effects will limit the use of the environment in the vicinity of the island impact areas, there is no foreseeable adverse effects on long-term environmental productivity.

The benefit of the proposed actio: in terms of achievements of mission objectives are considered to balance the short-term and limited adverse effects, and these effects will not result in long-term environmental losses or foreclose future options on the use of the environment.

IRREVERSIBLE AND IRRETRIEVABLE COMMITTMENTS OF RESOURCES

The effects on the environment and resources of Illeginni are expected to be short-term. Therefore the natural resources of Illeginni Island will not be irreversibly or irretrievably committed. Destruction of certain, potentially useful, structural facilities has been discussed on page 39.

NATIONAL DEFENSE CONSIDERATIONS THAT MUST BE BALANCED AGAINST THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

The anticipated adverse environmental effects of the proposed action are judged to be insignificant relative to national defense considerations of the proposed RV testing program.

CONCLUSION

The proposed action constitutes a testing of a military weapons system (specifically the Mark 12 arming and fusing system) and will involve a minimum of three re-entry vehicle impacts on the island or reef at Illeginni, Kwajalein Atoll. This action is consistent with land-use policies and agreements between the United States and Trust Territory of the Pacific Islands governments, and is in keeping with the designated mission of Kwajalein Missile Range (see DOD Directive No. 3200.11). The site selected is within the boundaries designated as the Mid-Atoll Corridor for missile impacts at Kwajalein Atoll.

The proposed action will result in limited damage to the natural environment at Illeginni within the immediate area of RV impact. The areas at Illeginni designated as intended targets are favorably situated to minimize long-term negative environmental effects. Furthermore, most adverse environmental effects can be mitigated by refilling craters on land and recovering RV debris from land and marine areas.

This action is not considered a major Federal action having a significant impact upon the quality of the human environments (MASAQHE) and the preparation of a Federal Environmental Impact Statement is not recommended at this time.

Nonetheless, because the total number of RV tests may exceed the three presently planned, and off-target RV impacts may result in adverse environmental effects beyond those envisioned for the designated target areas, it is recommended that data relevant to environmental assessment be gathered following the initial test. These data should enable a clearer evaluation of the effects on the ecology of Illeginni of continuing the test program and to serve as a basis for evaluating future programs of a similar nature. Impacts involving only zone "C" areas (Fig.s 17 and 18) would require no further action beyond

monitoring of crater depth and area, and distribution of impact fragments. RV impacts in areas designated as "A" or "B" zones should be examined from the standpoint of specific ecological effects. These off-target RV impacts, if of sufficient number or if resulting in damage of considerable extent, may require further environmental assessment.

REFERENCES CITED

Catala, R.L.A. 1957. Report on the Gilbert Islands: some aspects of human ecology. Atoll Res. Bull. No. 59. 187 pp.

Environmental Consultants, Inc. 1977. Reconnaissance survey of terrestrial and marine environments on Illeginni, Kwajalein Atoll. Prep. for U.S. Army Engineer Division, Pacific Ocean. Rept. No. ECI-145.

Fosberg, F.R. 1954. Soils of the Northern Marshall atolls with special reference to the Jemo Series. Soil Sci. 78(2).

Hatheway, W.H. 1953. The land vegetation of Arno Atoll, Marshall Islands. Atoll Res. Bull. No. 16.

_____. 1955. The natural vegetation of Canton Island, an Equatorial Pacific atoll. Atoll Res. Bull. No. 43.

Losey, G.S., Jr. 1973. Study of environmental impact for Kwajalein Missile Range. Prep. for U.S. Army Engineer Div., Pacific Ocean. 152 pp.

McKee, J.E. and H.W. Wolf. 1963. Water quality criteria. Second edition (reprint January 1973). Calif. State Water Resources Control Board. 548 pp.

Neal, M.C. 1965. In gardens of Hawaii. B.P. Bishop Mus., Spec. Publ. 50. Bishop Museum Press, Honolulu. 924 pp.

Niering, W.A. 1956. Bioecology of Kapingamarangi, Caroline Islands: terrestrial aspects. Atoll Res. Bull. No. 49.

Rogers, J.E. 1977. Letter of 8 Dec. 1977, to Mr. Daughtry, BMDSC, describing RV penetration prediction for land impact at Illeginni Island.

SAMTEC, Vandenberg AFB, 1978. Unclassified cable for BMDSC-RP (attn: Mr. Paul Kelly) outlining review comments of Draft Environmental Assessment for Missile Impacts, Illeginni Island, Kwajalein Missile Range, Nov. 1977, including combined inputs from SAMTEC, HQ SAC/DOMV, and ISTRAD/TEYM.

Shaw, H.K.A. 1952. On the distribution of *Pisonia grandis* R. Br. (Nyctaginaceae), with special reference to Malaysia. KEW Bull., pp. 87-97.

Taylor, R.C. 1973. An atlas of Pacific islands rainfall. Hawaii Inst. Geophys., Univ. Hawaii, Honolulu. HIG-73-9 (Data Rept. No. 25).

Taylor, W.R. 1950. Plants of Bikini and other Northern Marshall Islands. Univ. Michigan Studies, Sci. Ser. 18. Ann Arbor.

U.S. Army Corps of Engineers. 1973. Environmental assessment for KMR FY-73 construction for activities on Illeginni Island, Kwajalein Atoll, Marshall Islands District, TTPI. U.S. Army Corps of Engineers, Pacific Ocean Div., Honolulu. 24 pp.

U.S. Department of Commerce. 1976. Tide tables 1977. High and low water predictions. Central and western Pacific and Indian Ocean. U.S. Dept. of Commerce, NOAA and NOS. 383 pp.

Weins, H.J. 1962. Atoll environment and ecology. Yale Univ. Press, New Haven and London. 532 pp.

Wells, J.W. 1957. Coral reefs. p. 609-631 *In*: Treatise on marine ecology and paleoecology (edited by J.W. Hedgepeth). Geol. Soc. Amer., Mem. 67.

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DEPARTMENT OF THE ARMY

U. S. ARMY BALLISTIC MISSILE DEFENSE SYSTEMS COMMAND

POST OFFICE BOX 1500

HUNTSVILLE, ALABAMA 35807

SUBJECT: Environmental Impact Appraisal for Missile Impacts, Illeginni Island, KMR, Marshall Islands

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1. Reference is made to:

a. Council on Environmental Quality, Preparation of Environmental Impact Statements, Guidelines, Federal Register, Vol. 38, No. 147, August 1, 1973.

b. AR 200-1, Environmental Protection and Enhancement, C2, Chapter 2, 14 November 1975.

c. Inclosure 1, Environmental Assessment Missile Impacts, Illeginni Island, Kwajalein Missile Range, Kwajalein Atoll, Marshall Islands.

2. This document has been prepared in accordance with Section 1500.11(f) of References 1a and 1b which requires agencies to have available a record that briefly sets forth the reasons for a determination that an environmental statement is not required.

3. The management of environmental matters at the Kwajalein Missile Range (KMR) is the responsibility of the Kwajalein Missile Range Directorate (BMDSC-R) BMDSCOM. These responsibilities include the preparation of environmental assessment and statements for KMR in accordance with AR 200-1, Chapter 2, (Reference 1b).

4. Description of the Proposed Action: The proposed action, described in more detail by Inclosure 1, is to measure the performance of the Mark 12 arming and fusing system utilizing a mod 5T1 or 5T2 instrumented re-entry vehicle (RV).

ATCH 4

5. Summary of Adverse Environmental Impacts: The environmental assessment for the proposed action (Inclosure 1) concluded that no major adverse effects would occur. There would, however, be adverse effects consisting of limited damage to the natural environment within the immediate area of RV impact. The area designated as intended targets are favorably situated to minimize long-term negative environmental affects.

6. Alternatives Considered: Inclosure 1 describes alternatives which are limited to relocating the target areas to other islands in the Kwajalein Atoll and other islands in the Pacific.

7. Mitigation Measures: The environmental assessment described by Inclosure 1 and supported by other studies (see the references in Inclosure 1) enabled recommendations to be made for refilling craters on land and recovering RV debris from land and marine areas.

8. The described studies and the planned mitigation measures result in the conclusion that the proposed project as currently planned:

(1) is not a major action that will significantly affect the quality of the human environment

And

(2) is not now, or is likely to be, controversial.

On the basis of this conclusion, and in accordance with established procedures, it has been decided that an environmental impact statement will not be prepared.

9. This document and supporting studies will be placed on file at the Facilities Engineering & Environmental Office, KMRD, Huntsville, Alabama, and will be made available for inspection by request through appropriate channels.

[redacted]
Colonel, GS
Director, Kwajalein Missile
Range Directorate